Influence of ENSO on the west African monsoon

Temporal aspects and atmospheric processes

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CNRM Météo-France

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CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
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AMMA

Introduction

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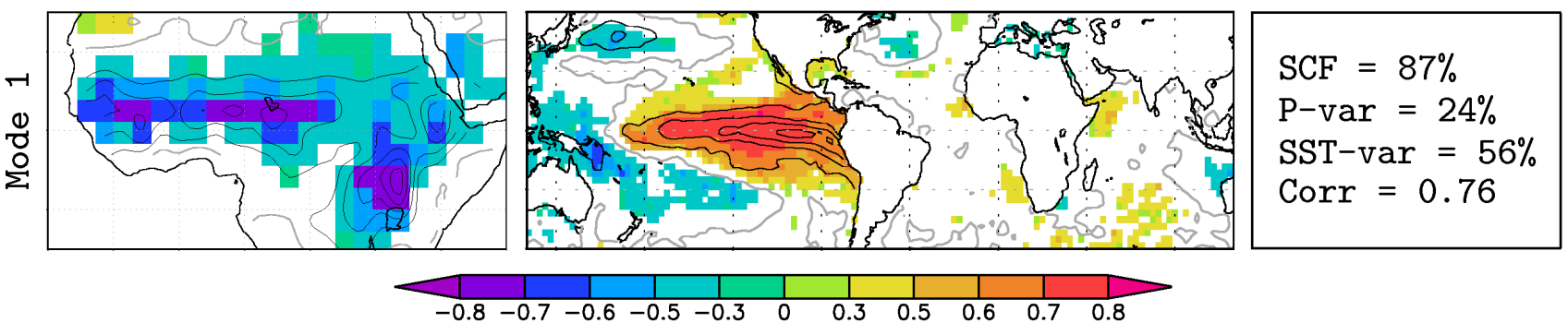
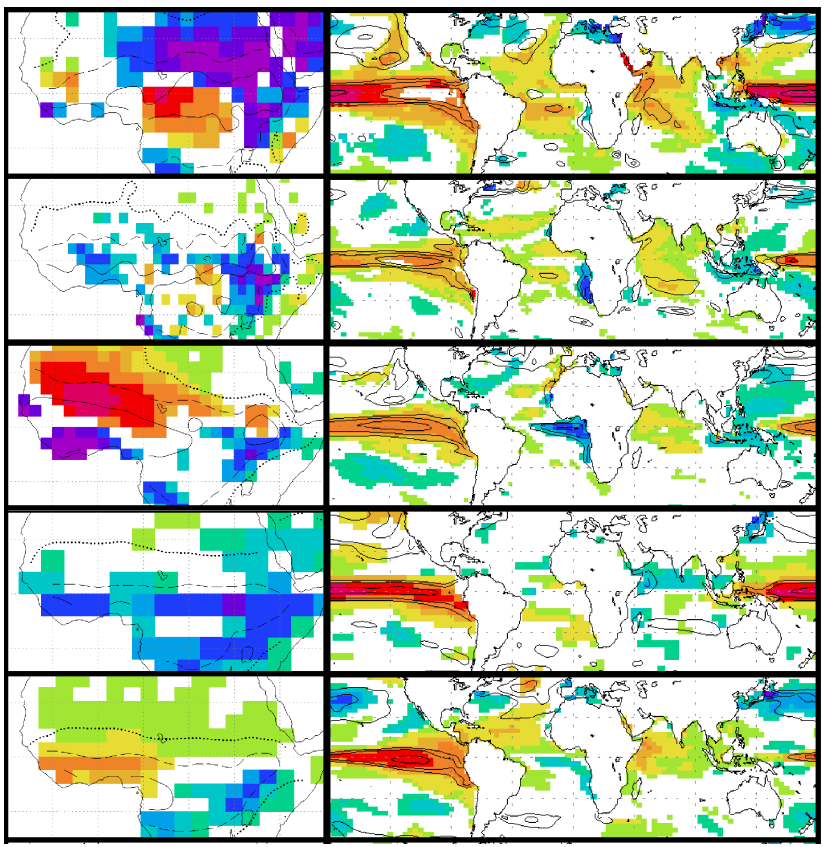
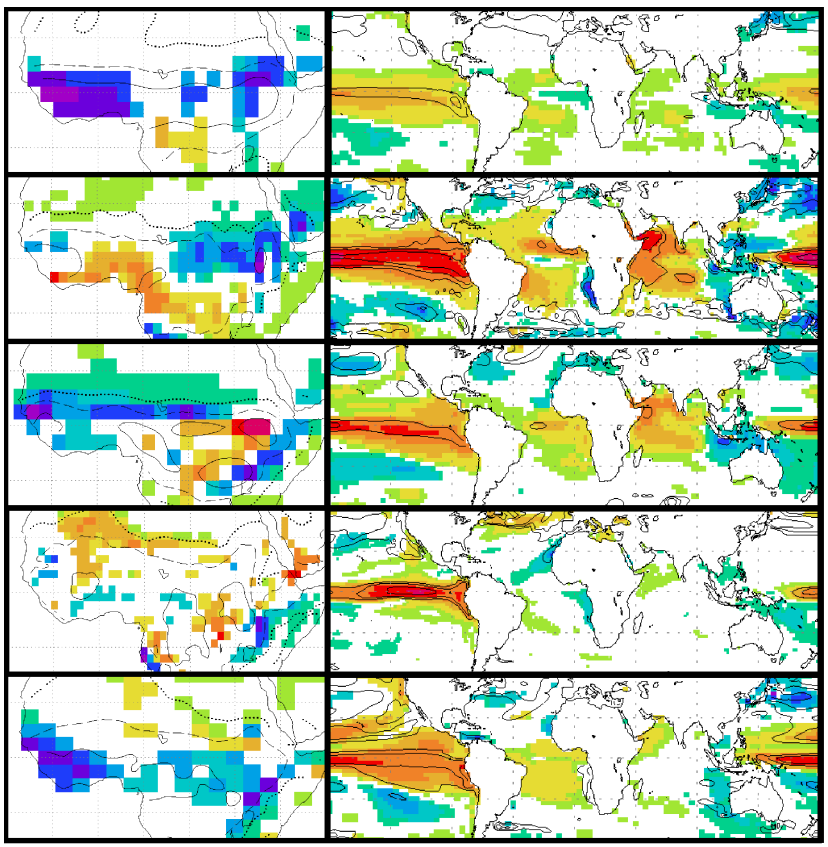
Maximum Covariance Analysis

WAM rainfall (CRU) & Tropical SST (HadISST)
(filtered 1951-2002 JAS anomalies)



In **Joly et al. (2007)**, we show that SST–WAM teleconnections are quite different from one model to another:





The question is...

Why is the ENSO teleconnection simulated in state-of-the-art **coupled models** so different from the observed one?

Outline

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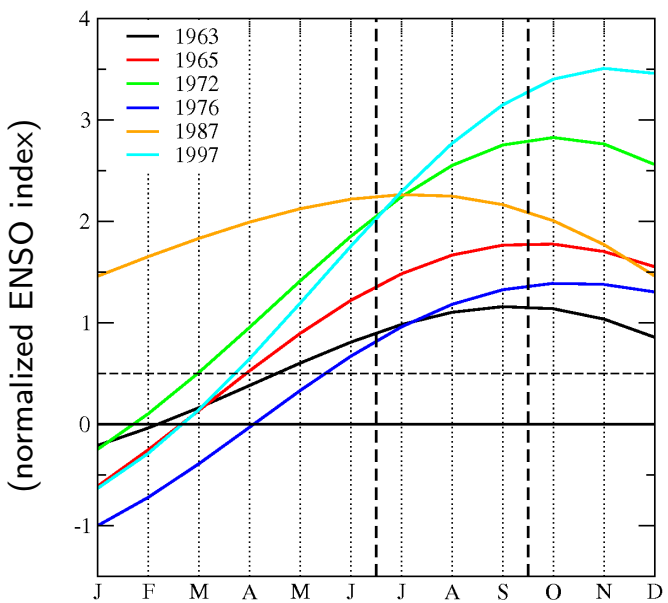

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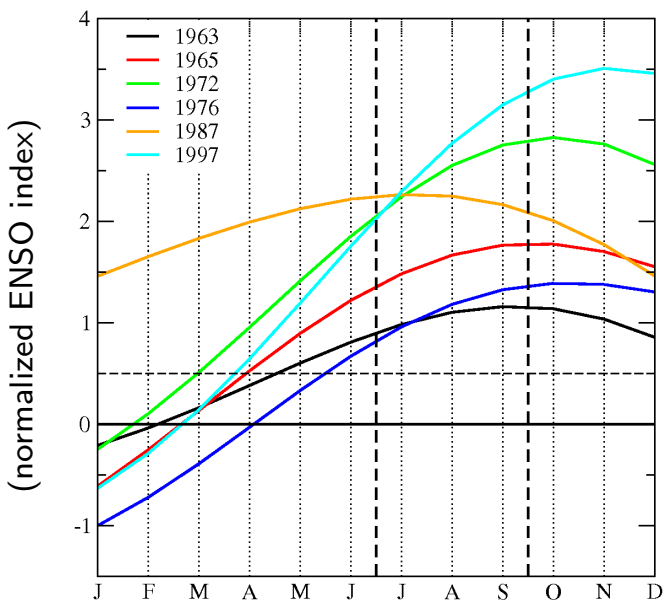
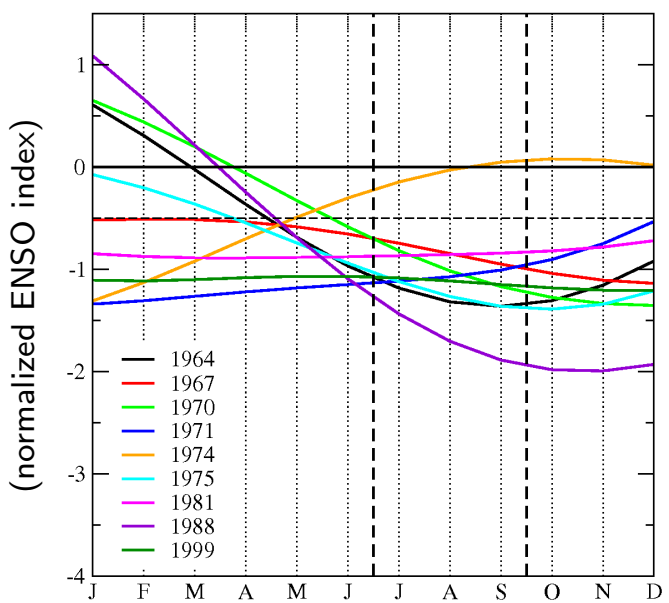


Niña & Strong WAM



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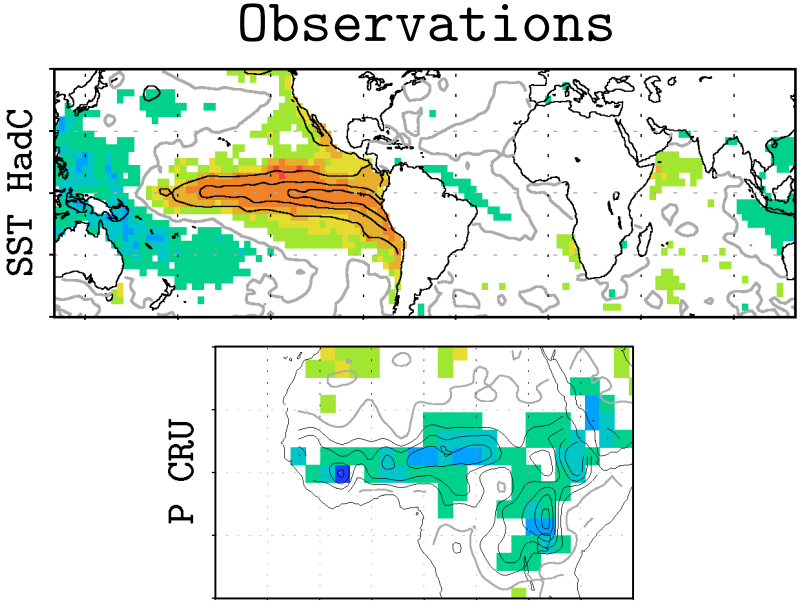
▷ What are the mechanisms of the rapid teleconnection that takes place at the beginning of ENSO events?

(Niño-Niña) JAS composite anomalies



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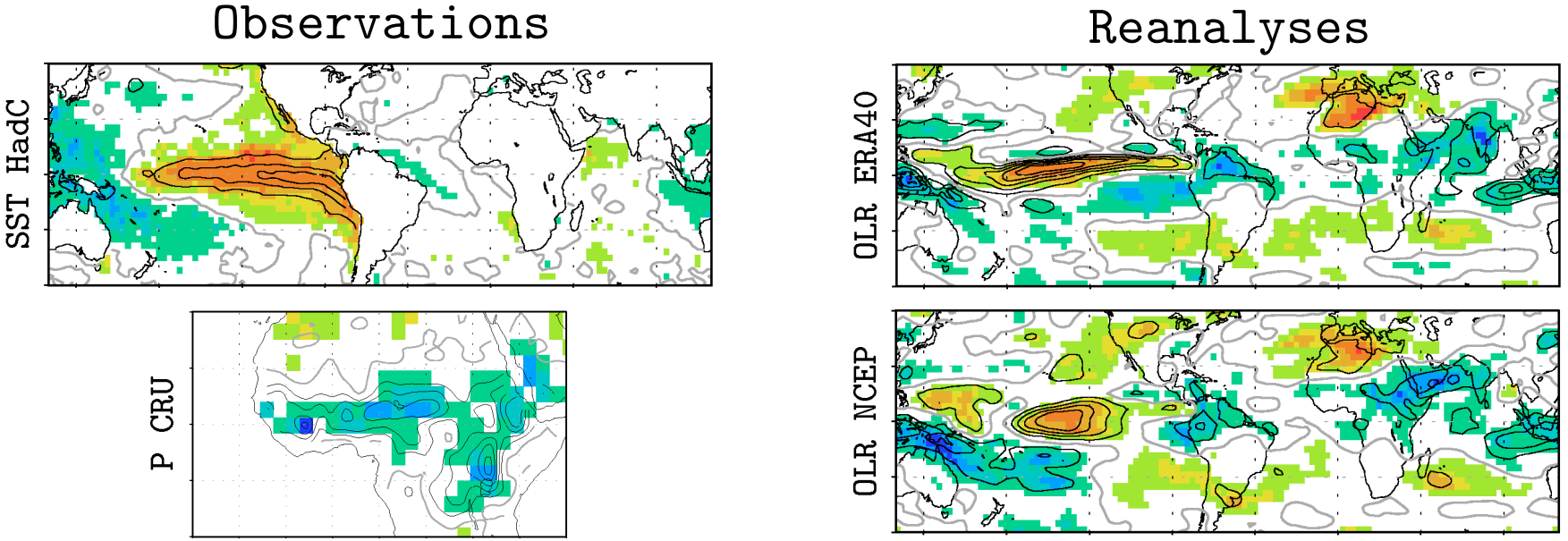

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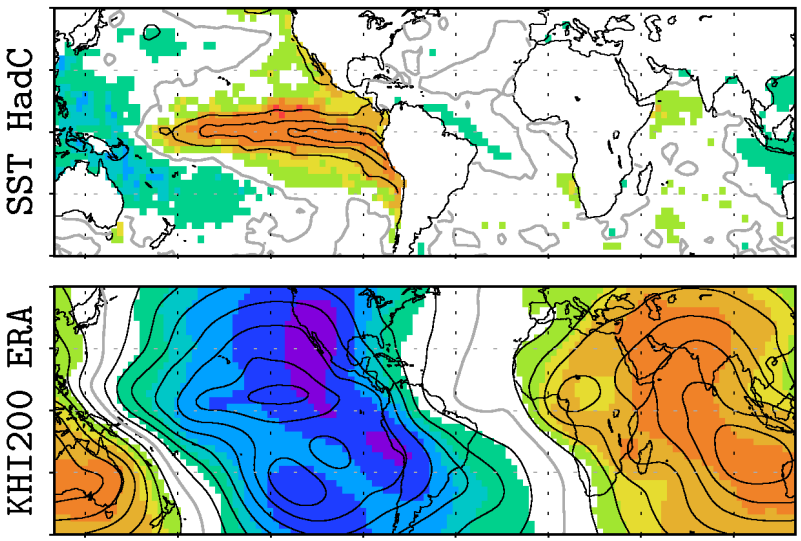

▷ Modulation of the large-scale subsidence over Africa.

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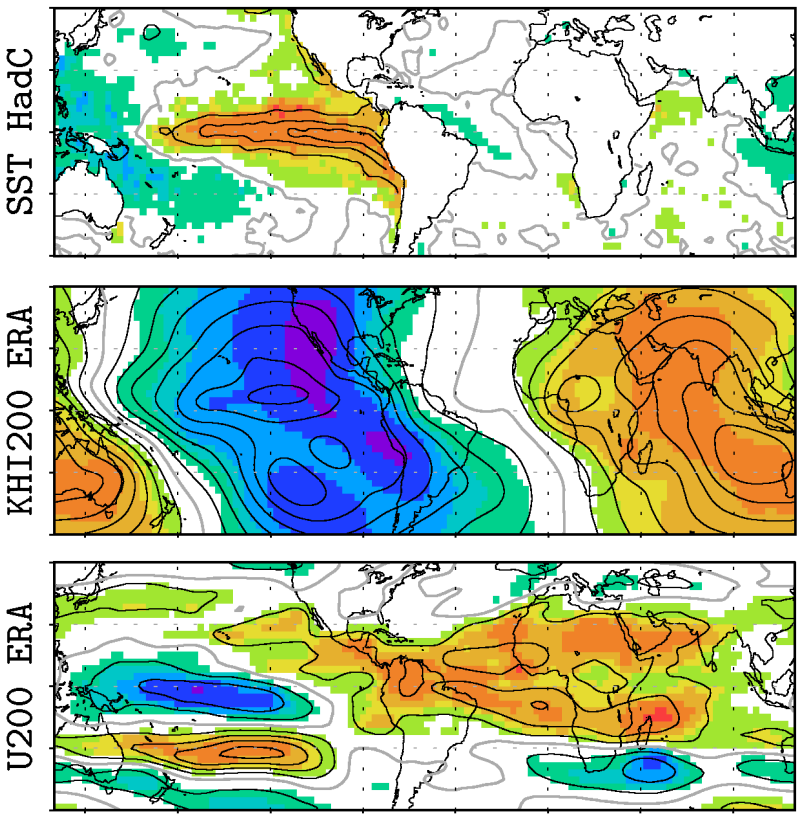
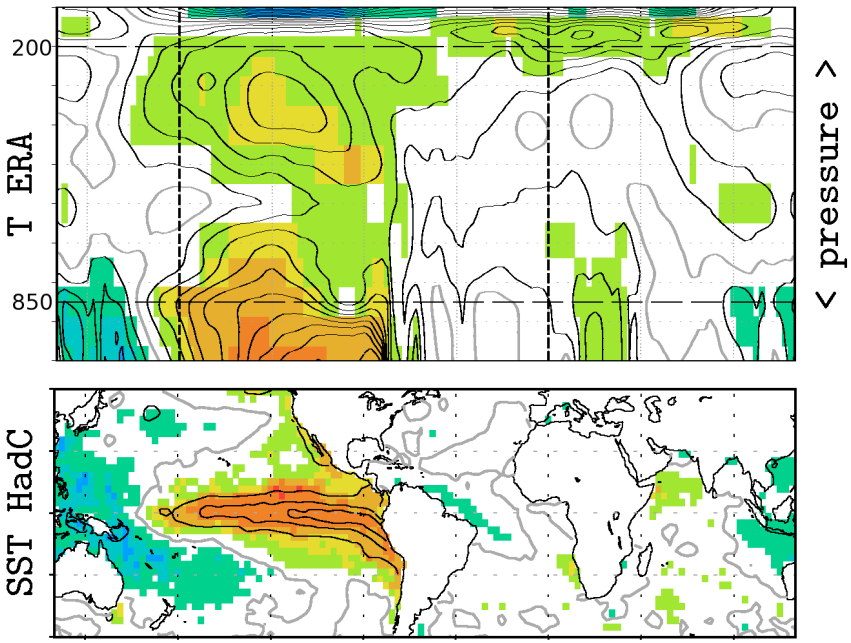


▷ Modulation of the large-scale subsidence over Africa.

▷ Modulation of the TEJ.

2) Temperature anomalies



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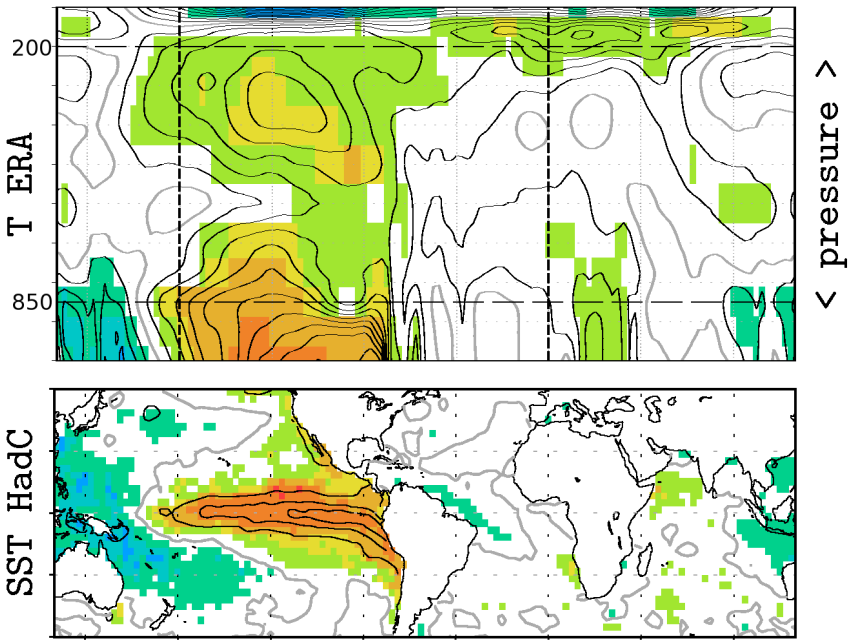
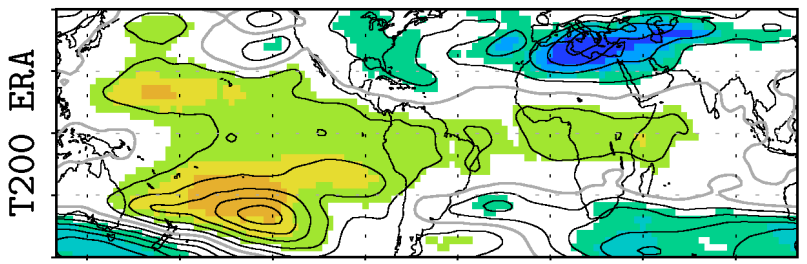
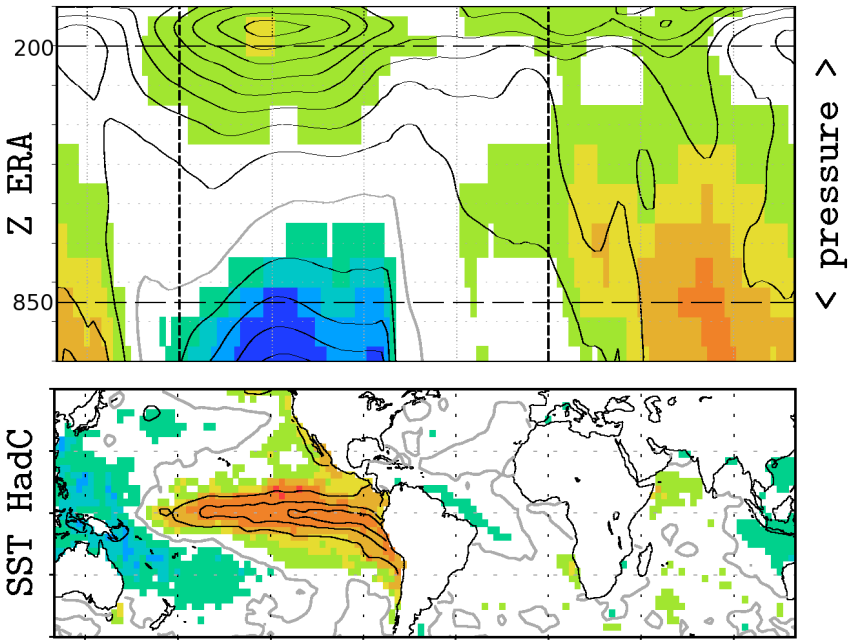
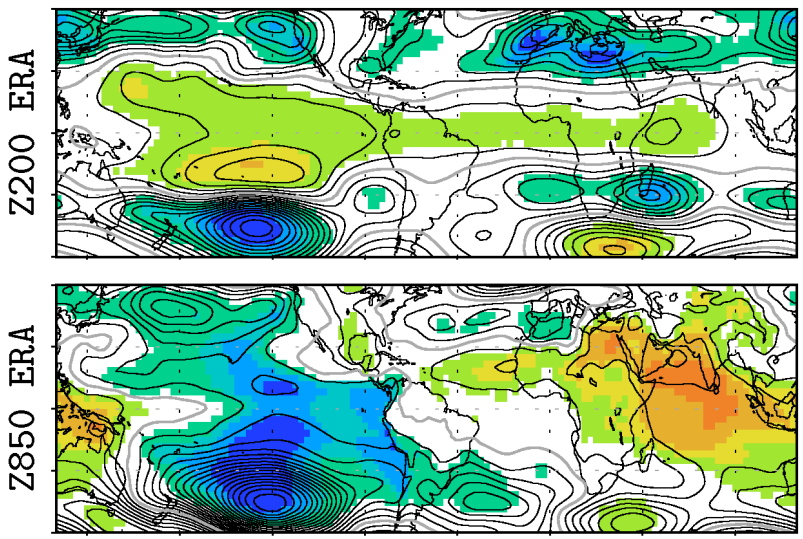




3) Geopotential anomalies





The observed ENSO teleconnection

Atmospheric mechanisms...

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  - ▷ Temperature & Geopotential anomalies

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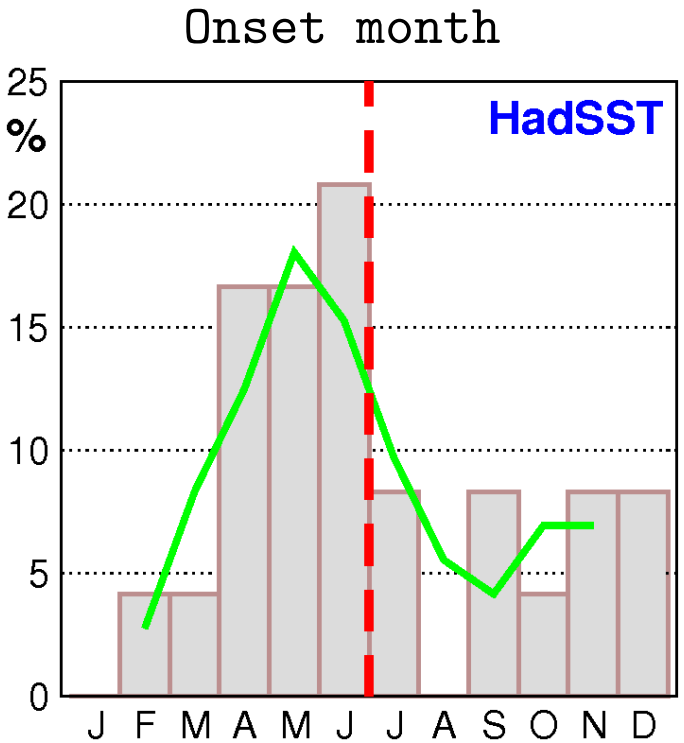
  - ▷ Modulation of the TEJ
- Kelvin stationary wave in the **high-troposphere**
  - ▷ Temperature & Geopotential anomalies
- Geopotential anomaly in the **low-troposphere**
  - ▷ Modulation of the monsoon flow *(not shown)*

1) Onset of ENSO events



▷ In the **observations**, most of the ENSO events start in AMJ, before the monsoon season.

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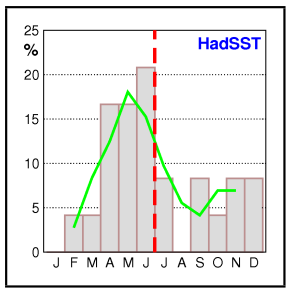

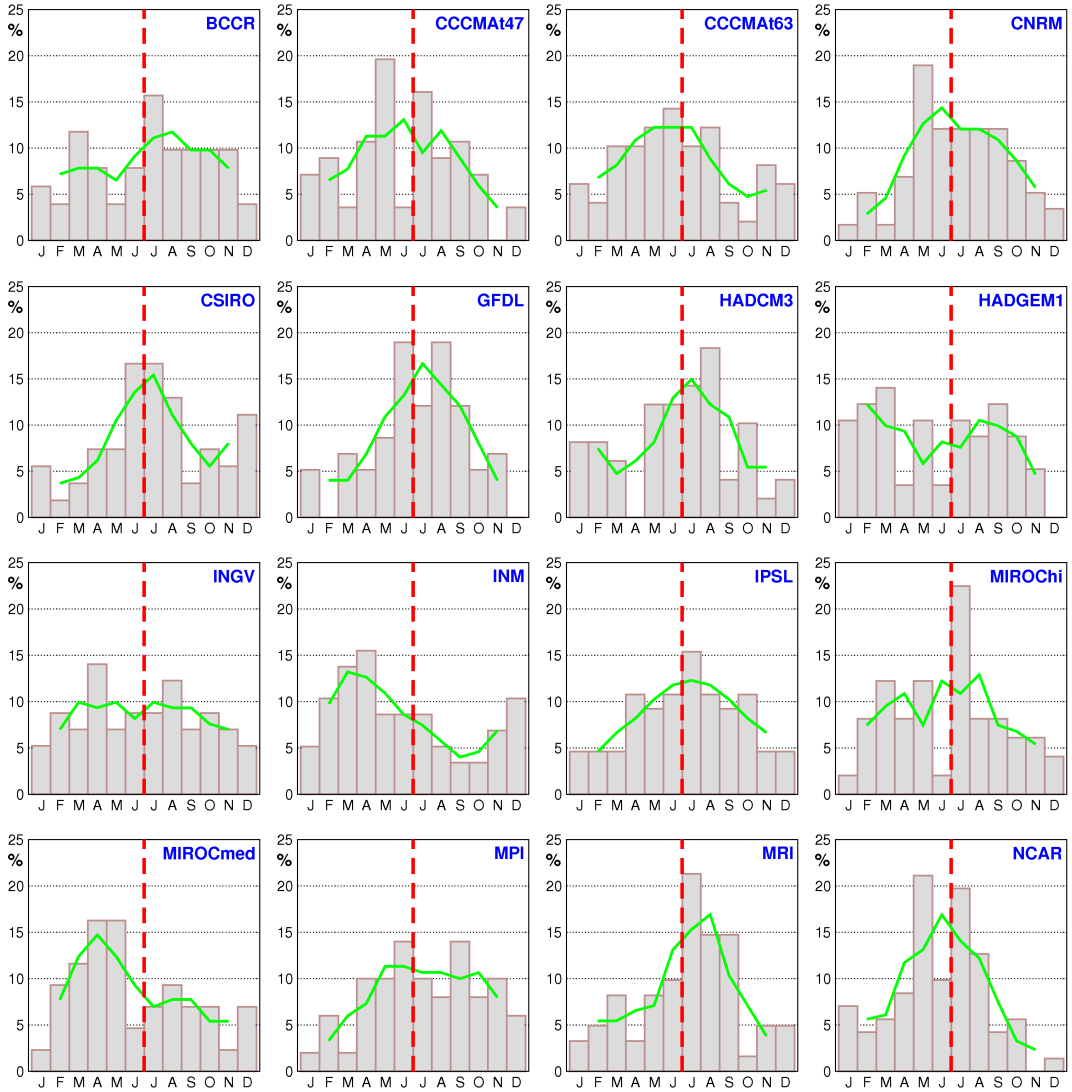

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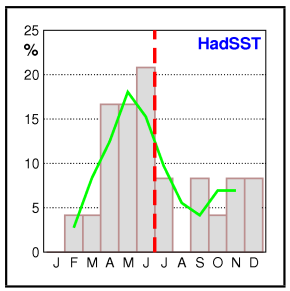

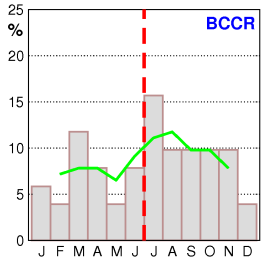

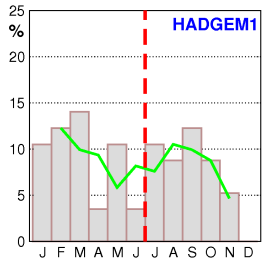

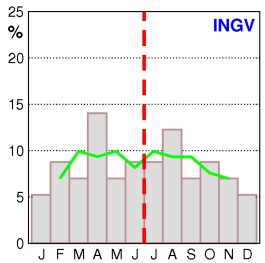

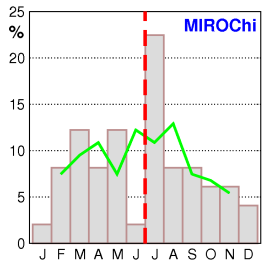

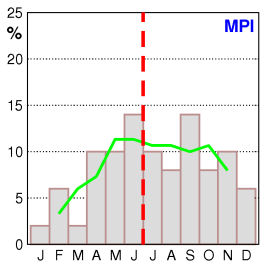

▷ In 5 simulations, there is no marked peak in the distribution.

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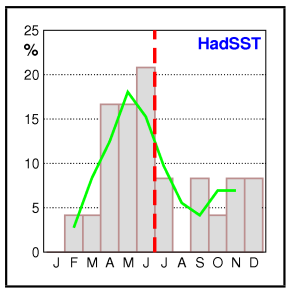
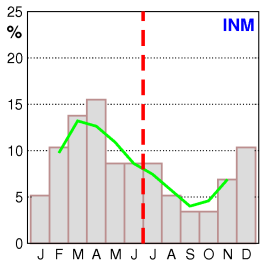
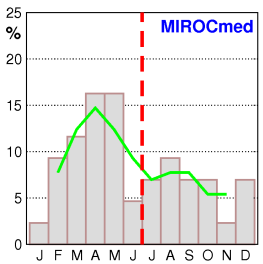


▷ In 2 simulations, ENSO events appear in spring.





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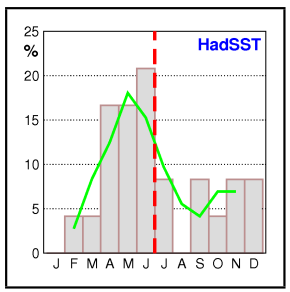
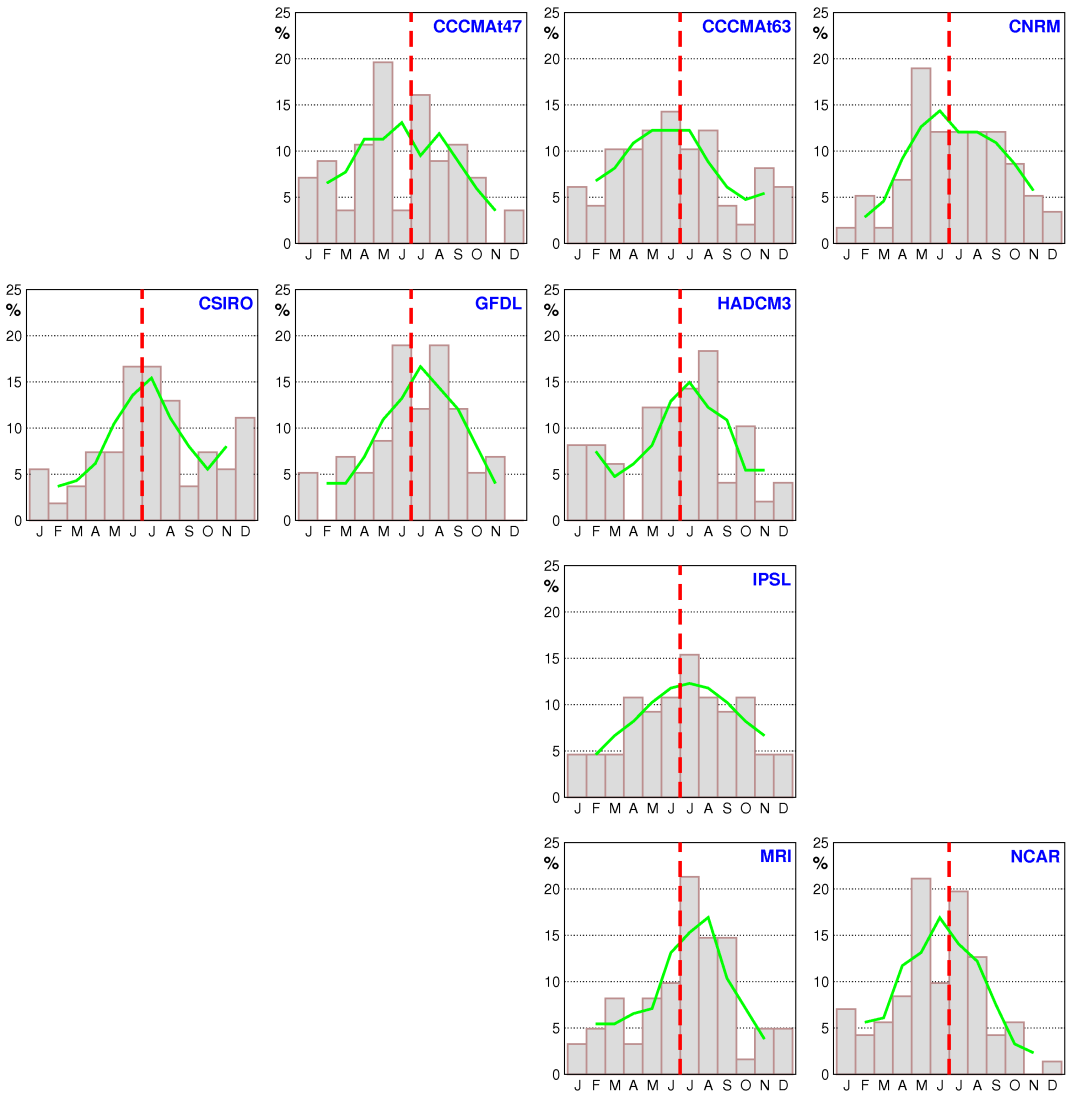


▷ In the 9 remaining simulations, the peak arises **later** than in the observations.



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- 4 models show a striking Niño/Niña dissymmetry *(not shown)*.

2) Time-lag of the atmospheric response over Africa

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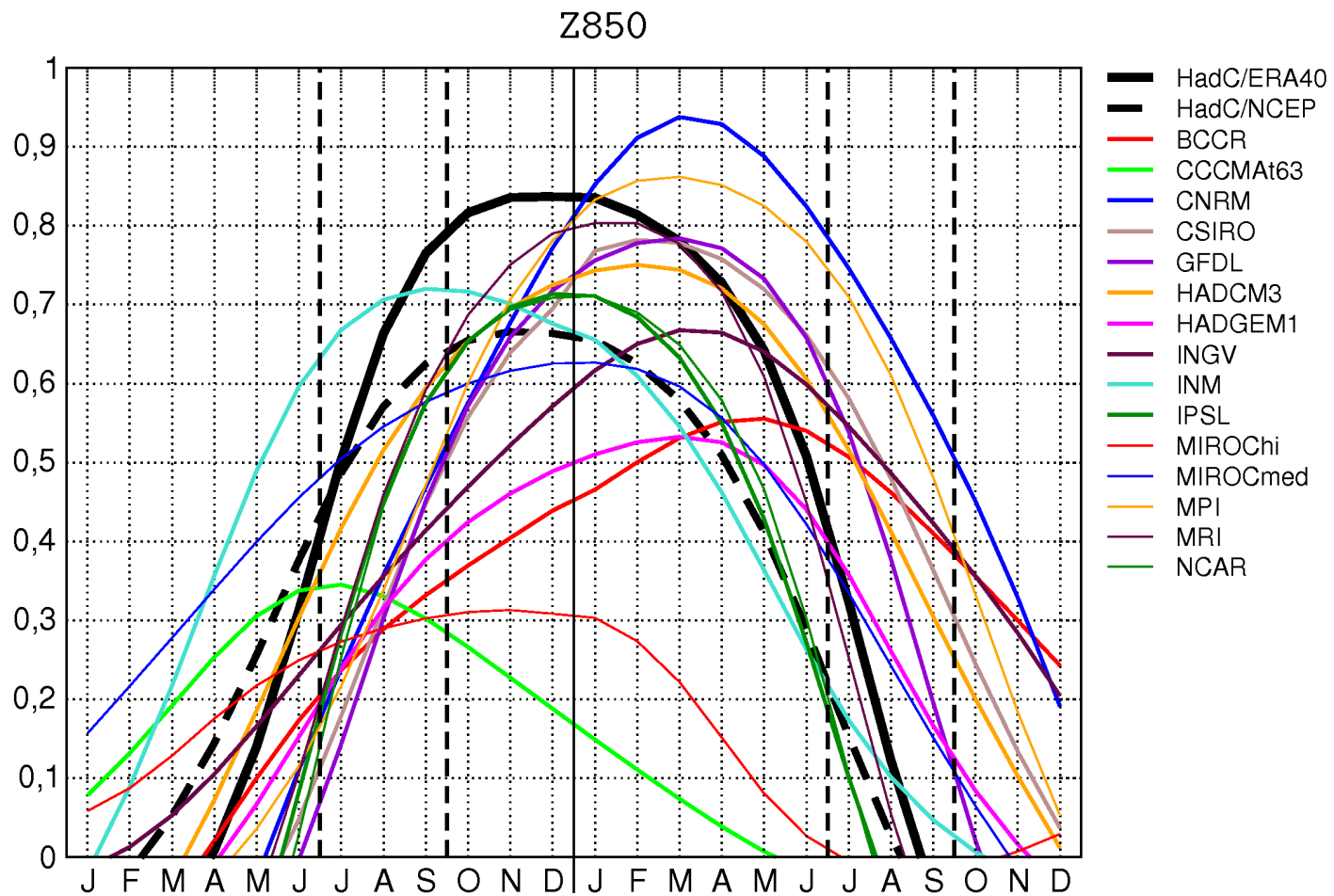
Lag-correlations : ENSO index *vs* Geopotential over Africa



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At 850hPa, the response can be very different from one model to another:

- In 2 models, there is no significant signal,
- In 7 simulations, the response is slower (at least 2 months) than in the reanalyses.

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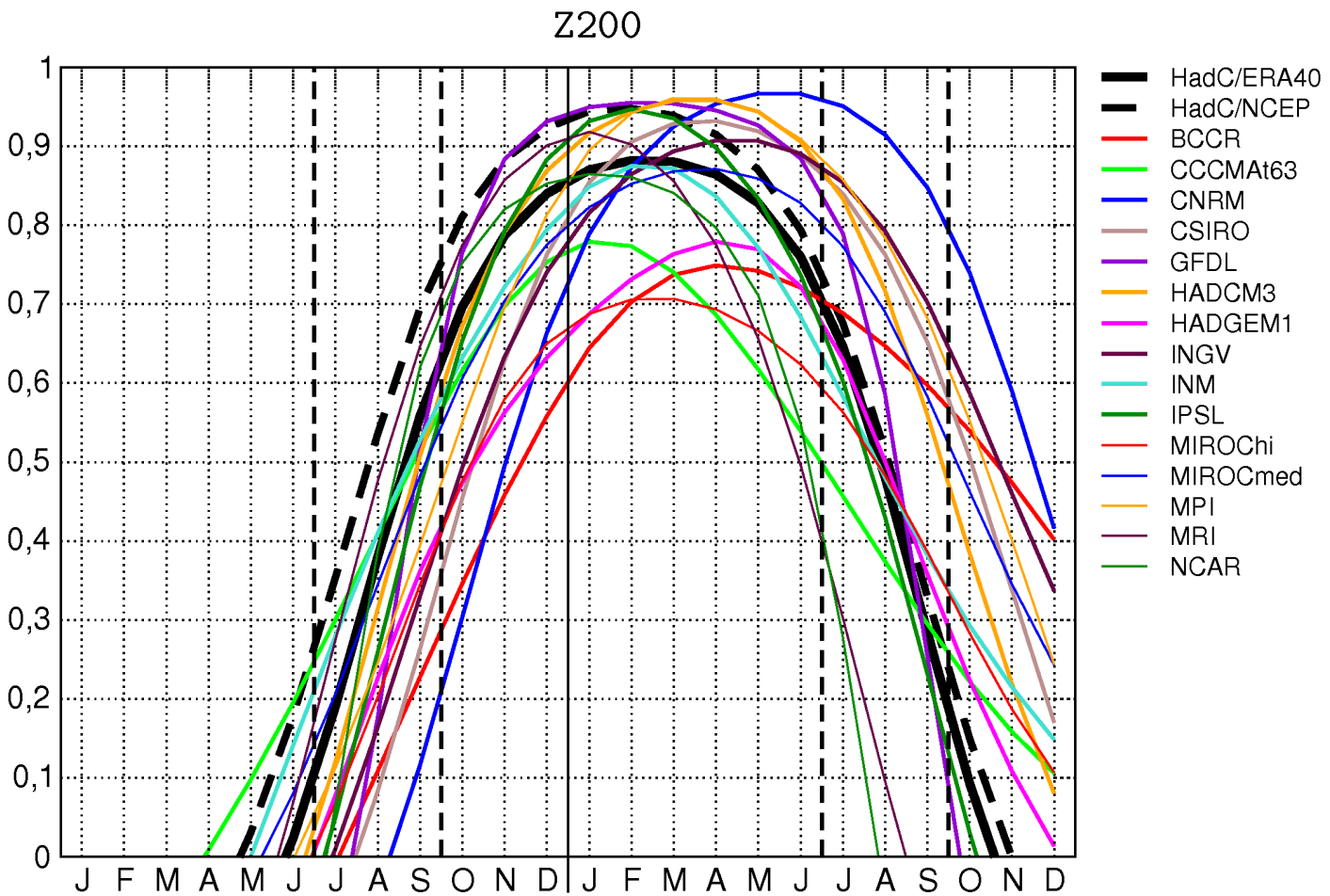

Time-lag of the atmospheric response over Africa...

At 200hPa, simulations show less spread than at 850hPa, but the response is often slower than in the reanalyses (one month on average).

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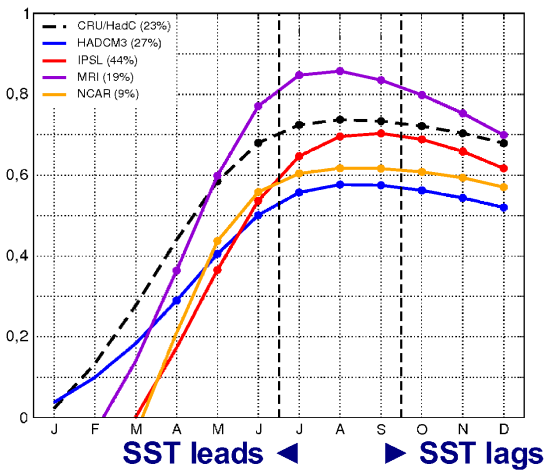

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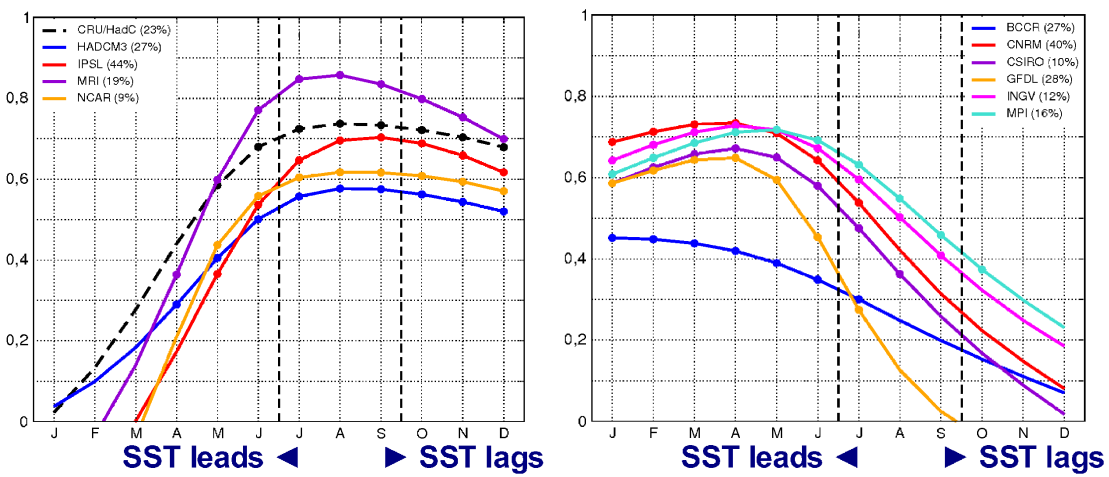

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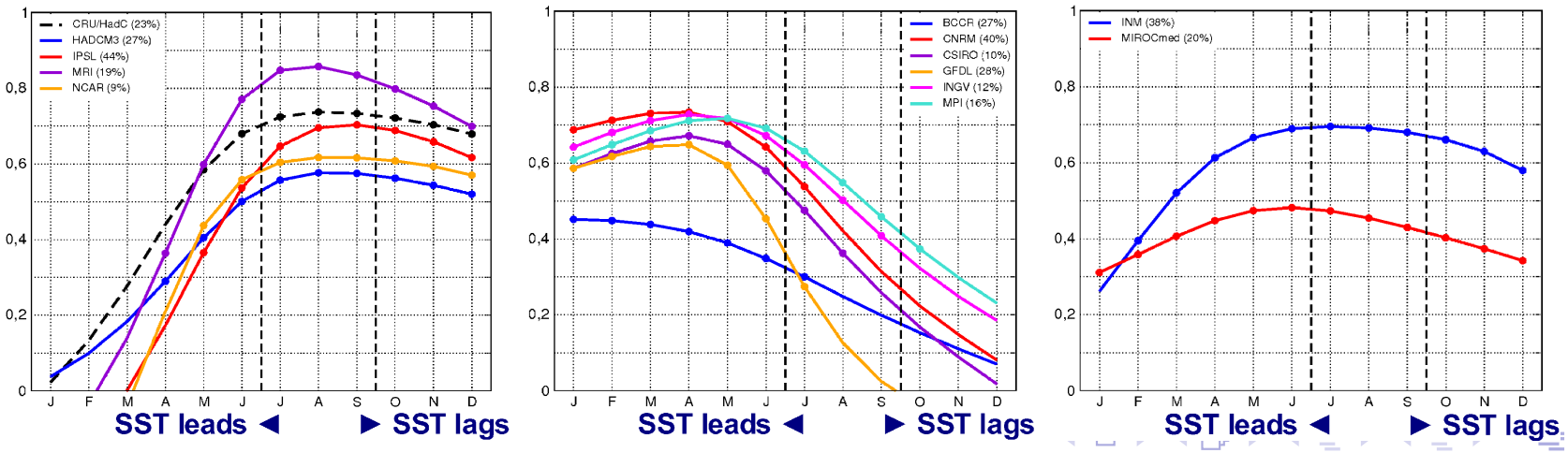

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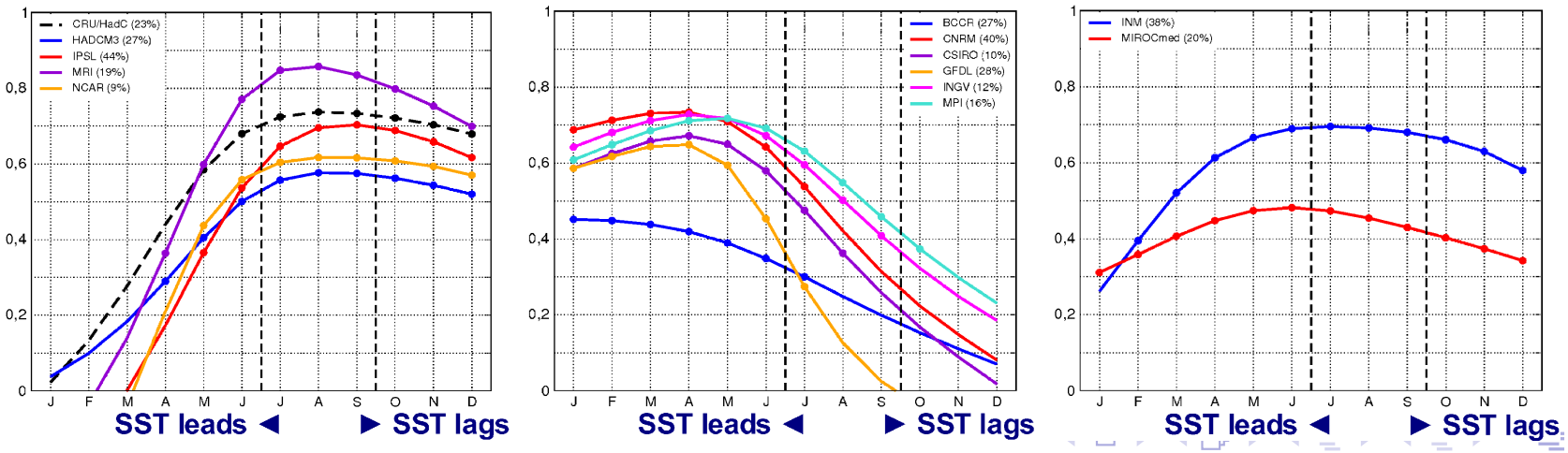

1. The observed ENSO teleconnection

2. The ENSO teleconnection in IPCC-AR4 simulations
   - Onset of ENSO events
   - Time-lag of the atmospheric response over Africa
   - Resulting ENSO teleconnection

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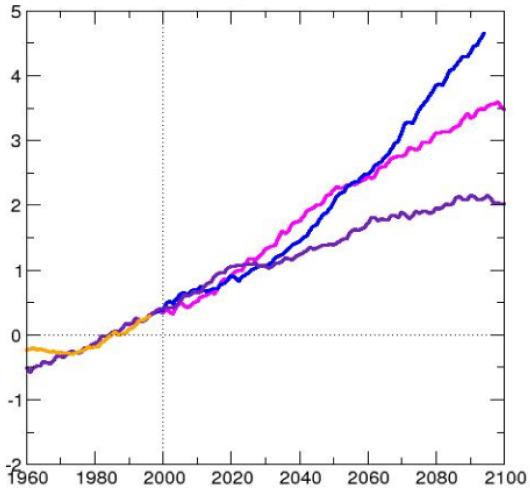
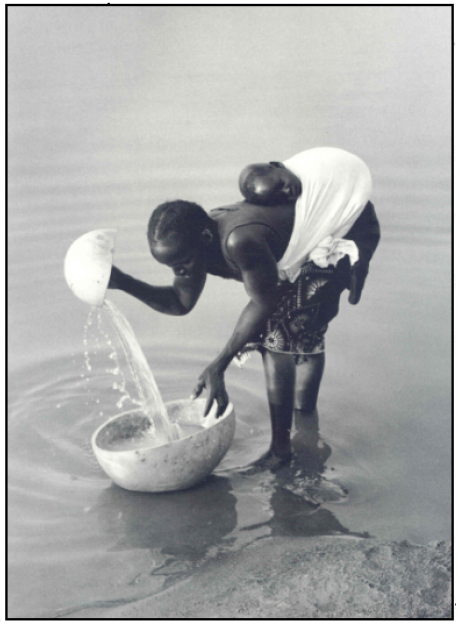
Beyond these "timing" issues...

Very few models simulate correctly the response of **WAM rainfall** (sign and patterns) to ENSO-related atmospheric anomalies.

Thank you !





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